

RICHARD L. SANDBERG

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EDUCATION:

PhD, M.S. in Physics, Certificate of Optics—University of Colorado at Boulder and JILA

- Graduation: May 2009, GPA 3.7
- Thesis: "Closing the Gap to the Diffraction Limit: Near Wavelength Limited Tabletop Soft X-Ray Coherent Diffractive Imaging"
- Also completed NSF IGERT Optical Science and Engineering Fellowship Program and industrial internship with Advanced Micro Devices (AMD), Inc. Fall 2006
- Advisors: Margaret M. Murnane and Henry C. Kapteyn

B.S. in Physics, minors in Mathematics and Business—Brigham Young University

- Graduation: August 2004 Graduated with Honors (Top 1% of University), GPA 3.8
- Honors Thesis: "Optical applications of Uranium Thin-film Compounds for the Extreme Ultraviolet and Soft X-ray Region"
- Advisors: David D. Allred and R. Steven Turley

ACHIEVEMENTS AND AWARDS

- 2014 Los Alamos Performance Award for Dynamic X-ray Imaging Experiments on Explosives
- 2012-2013 LANL Protégé/Mentor Program (Mentors: 2012 D. Idar, PADGS; 2013 D. Fulton, P-DO)
- 2012 Los Alamos New Manager On-Ramp Program Endorsement
- 2012 Los Alamos Awards Program (LAAP) Winner, Gemini Project Diagnostic Development
- 2010 Los Alamos National Laboratory "Spot" Performance Award
- 2009 Director's Postdoctoral Fellowship at Los Alamos National Laboratory
- 2008 Optical Society of America (OSA) New Focus/Bookham Student Award Recipient
- Finalist for the 2008 Werner Meyer-Ilse Memorial Award at XRM 2008
- 5 year NSF IGERT Optical Science and Engineering Program Graduate Fellowship, August 2004
- Best Presentation of X-Ray/UV Optics Technical Group at SPIE 48th Annual Meeting Aug. 4th, 2003
- Member of Sigma Pi Sigma, National Honor Society of Physics Students
- 2003 BYU Office of Research and Creative Activities (ORCA) Grant
- 2003 SPIE Educational Scholarship in Optical Science and Engineering
- 2003 John Hale Gardner Scholarship

PROFESSIONAL AFFILIATIONS

American Physical Society (APS); Optical Society of America (OSA); International Organization for Optical Engineers (SPIE); Materials Research Society (MRS); The Minerals, Metals, and Materials Society (TMS)

PROFESSIONAL ACTIVITIES

- 2015-Present - Optical Society of America CLEO Conference Program Committee on Optical Interactions with Condensed Matter and Ultrafast Phenomena

- 2015 – Los Alamos National Laboratory Science Campaign 2 Program Manager Search Committee
- December 2014 – Present – SLAC LCLS-II Magnetism & Spin Working Group and LCLS-II Science Opportunities Document Team
- October 2014 – Present – SLAC – Linac Coherent Light Source (LCLS) User Executive Committee
- 2014 – Center for Integrated Nanotechnologies Co-Director and Group Leader
- 2013-Present - TMS Advanced Characterization, Testing, and Simulation Committee Member
- 2013-2014 - Optical Society of America CLEO Conference Applications and Technology 3 Committee
- Co-organizer of a special symposium at the TMS Annual meeting entitled: "Characterization of Materials through High Resolution Coherent Imaging" (2013,2015) – *to be held bi-annually*.
- Guest Editor of Special Section for the Journal of the Minerals, Metals, and Materials Society (JOM) on "Coherent X-ray Diffraction Imaging as a Characterization Tool" September 2013
- 2012-Present – Los Alamos Laboratory Directed Research and Development (LDRD) Review Committee for Exploratory Research Programs: FY2013 – Emergent Phenomenon of Materials (EPM), FY2014 – FY2015 – Quantum and Optical Sciences (QOS), Committee Chair FY2016 – Atomic, Molecular, Quantum, and Optical Sciences (AMQOS)
- Reviewer for *Nature Physics*, *Nature Photonics*, *Proceedings of the National Academy of Science*, *Physical Review Letters*, *Physical Review B and X*, *New Journal of Physics*, *Optics Letters*, *Optics Express*, and *Journal of the Optical Society of America B*

RESEARCH AND TEACHING EXPERIENCE

Staff Member, Laboratory for Ultrafast Materials and Optical Science (LUMOS), Center for Integrated Nanotechnology (MPA-CINT) at Los Alamos National Laboratory April 2011-Present

Development of coherent x-ray diffractive imaging (CXDI) for materials studies, especially materials under extremes using tabletop sources and large user facilities. Support development of MaRIE first experiments and experimental designs. Use of ultrafast lasers to probe materials with under extreme conditions (shock, detonation).

Director's Postdoctoral Fellow in the Center for Advanced Solar Photophysics (CASP), C-PCS Group at Los Alamos National Laboratory with Han Htoon and Victor Klimov June 2009-April 2011

Use of ultrafast lasers (Ti:Sapph pumped OPA's) to study multiple-exiton dynamics of semiconductor quantum dots. Use of superconducting nanowire single photon detectors (SNSPD) to perform photon correlation studies of single quantum emitters such as semiconductor nanocrystals to study carrier multiplication.

Postdoctoral Research Associate with Kapteyn/Murnane Group, JILA/CU-Boulder April-May 2009

NSF IGERT Graduate Fellow with Kapteyn/Murnane Group, JILA/CU-Boulder May 2005-Dec 2008

Generation of coherent extreme ultraviolet light via high harmonic generation and use of this light for state of the art coherent imaging applications. Demonstration of the first tabletop EUV lensless microscope. Alignment of Ti:Sapph oscillators and amplified lasers

Teaching Assistant, Substitute, and Class Demo Coordinator , CU-Boulder May 2005-Dec 2008

Tutoring students for introductory undergraduate non-major physics courses (Phys 1010-1020 Physical Science for Nonscientists, 2010-2020 General Algebra Based Physics series: Mechanics and Electro-magnetics); graded for graduate Lasers class (Phys 5160); substitute teacher for Graduate Lasers Course, Physical Science for Nonscientists series, Gen. Alg. Based Series, and for Light and Color for Nonscientists (Phys 1230); coordinated, setup, and helped run physics class demonstrations for General Algebra Based Physics series: Mechanics and Electro-magnetics (Spring 2008).

Industrial Internship with Advanced Micro Devices, Inc.*Aug-Dec 2006*

Worked with strategic lithography group under Bruno LaFontaine on characterizing a ASML 1700i Hyper-NA Immersion stepper through scatterometry and on characterizing EUV resists exposed at the EUV micro-exposure tool at the Advanced Light Source.

Research Assistant with David Pappas, NIST-Boulder*Jan 2005-May 2005*

Set up a tabletop entangled photon source for demonstration of Einstein-Podolsky-Rosen Paradox violation using laser diode pumped (405 nm) BBO

Research Assistant with Dan Dessau, CU-Boulder*Sept 2004-Dec 2004*

Used an optical parametric oscillator pumped by a titanium-sapphire oscillator for studies of super conducting samples: experience in aligning oscillators, cavity design

Research Assistant with Thin Films Research Group at BYU*June 2001-Aug 2004*

Under David Allred and Steven Turley studied optical properties of thin films for the extreme ultra-violet region, created thin film samples through in situ vacuum deposition, characterized samples using x-ray diffraction, monochromatic reflectance, atomic force microscopy, x-ray photoelectron spectroscopy, and ellipsometry, presented research in regional and national meetings, aided in publishing process

Physics Teaching Assistant at BYU*Sept 2001-Dec 2002*

Lab course taught: Physics laboratory for non-majors (Phys 107)

Courses: Introductory mechanics (Phys 121), introductory fluid dynamics/optics (Phys 123), and introductory electro-magnetics (Phys 220)

PEER REVIEWED PUBLICATIONS (Google Scholar Citations – April 2015: 743, h-index: 11, i10-index: 12)

1. Arianna E. Gleason, Cindy A. Bolme, Hae Ja Lee, Bob Nagler, Eric Galtier, Despina Milathianaki, Richard L. Sandberg, James Hawrelak, Richard G. Kraus, Jon H. Eggert, Dayne E. Fratanduono, Gilbert W. Collins, Wenge Yang, and Wendy L. Mao, "Ultrafast visualization of crystallization and grain growth in 1 shock-compressed SiO₂," *under review Nature Comm.* (2015).
2. J.L. Barber, C.W. Barnes, R.L. Sandberg, and R.L. Sheffield, "Diffractive imaging at large Fresnel number: Challenge of dynamic mesoscale imaging with hard x-rays," *Phys. Rev. B* **89**, 184105 (2014).
3. **Invited Review:** R.L. Sandberg, Z. Huang, R. Xu, J. Rodriguez, and J. Miao, "Studies of Materials at the Nanometer Scale Using Coherent X-Ray Diffraction Imaging," *JOM* **65**, 1208 (2013).
4. G. Rodriguez, R. L. Sandberg, Q. McCulloch, S. I. Jackson, S. W. Vincent, and E. Udd, "Chirped fiber Bragg grating detonation velocity sensing," *Rev. Sci. Instrum.* **84**, 015003 (2013).
5. L.A. Padilha, J.T. Stewart, R.L. Sandberg, W.K. Bae, W.-K. Koh, J.M. Pietryga, and V.I. Klimov, "Aspect Ratio Dependence of Auger Recombination and Carrier Multiplication in PbSe Nanorods," *Nano Letters* **13**, 1092 (2013).
6. **Invited Article:** L.A. Padilha, J.T. Stewart, R.L. Sandberg, W.K. Bae, W.K. Koh, J.M. Pietryga, and V.I. Klimov, "Carrier Multiplication in Semiconductor Nanocrystals: Influence of Size, Shape and Composition," *Acc. Chem. Res.* **46**, 1261-1269 (2013).
7. R.L. Sandberg, L. a Padilha, M.M. Qazilbash, W.K. Bae, R.D. Schaller, J.M. Pietryga, M.J. Stevens, B. Baek, S.W. Nam, and V.I. Klimov, "Multiexciton dynamics in infrared-emitting colloidal nanostructures probed by a superconducting nanowire single-photon detector," *ACS Nano* **6**, 9532 (2012).
8. **Invited Review:** J. Miao, R.L. Sandberg, and C. Song, "Coherent X-Ray Diffraction Imaging," *IEEE Journal of Selected Topics in Quantum Electronics* **18**, 399 (2012).

9. K.S. Raines, S. Salha, H. Jiang, R.L. Sandberg, H.C. Kapteyn, M.M. Murnane, J. Du, and Jianwei Miao, "Ankylography: three-dimensional structure determination from a single view," *Nature* **463**, 214-217 (2010).
10. R.L. Sandberg, D.A. Raymondson, C. La-o-vorakiat, A. Paul, K.S. Raines, J. Miao, M.M. Murnane, H.C. Kapteyn, and W.F. Schlotter, "Tabletop soft-x-ray Fourier transform holography with 50 nm resolution," *Opt. Lett.* **34**, 1618 (2009).
11. R.L. Sandberg, C. Song, P.W. Wachulak, D.A. Raymondson, A. Paul, B. Amirkian, A.E. Sakdinawat, E. Lee, C. La-O-Vorakiat, M.C. Marconi, C.S. Menoni, M.M. Murnane, J.J. Rocca, H.C. Kapteyn, J. Miao "High numerical aperture tabletop soft x-ray diffraction microscopy with 70-nm resolution," *Proc. Natl. Acad. Sci. USA* **105**, 24 (2008).
12. A.L. Lytle, X. Zhang, R.L. Sandberg, O. Cohen, H.C. Kapteyn, and M.M. Murnane, "Quasi-phase matching and characterization of high-order harmonic generation in hollow waveguides using counterpropagating light," *Opt. Exp.* **16**, 6544-6566 (2008).
13. B. La Fontaine, Y. Deng, R. Kim, H.J. Levinson, U. Okoroanyanwu, R.L. Sandberg, T. Wallow, and O. Wood, "Extreme ultraviolet lithography: From research to manufacturing," *J. Vac. Sci. Technol. B* **25**, 2089 (2007).
14. R.L. Sandberg, A. Paul, D.A. Raymondson, S. Hädrich, D.M. Gaudiosi, J. Holtsnider, R.I. Tobey, O. Cohen, M.M. Murnane, H.C. Kapteyn, C. Song, J. Miao, Y. Liu, and F. Salmassi, "Lensless diffractive imaging using tabletop, coherent, high harmonic soft x-ray beams," *Phys. Rev. Lett.* **99**, 098103 (2007).
15. Kristi Adamson, Shannon Lunt, Richard Sandberg, Elke Jackson, David Allred, R. Steven Turley , "Determining Composition of Thin Films of Uranium Oxide by X-Ray Photoelectron Spectroscopy," *The Journal of the Utah Academy of Sciences, Arts, and Letters* **82**, 176-186 (2005).

Newsbriefs highlighting work

1. "First in-situ images of void collapse in explosives," LANL Home Page highlight, July 2014 (<http://www.lanl.gov/science-innovation/features/science-digests/void-collapse-in-explosives.php>)
2. "Ankylography permits three-dimensional structure determination from a single sample orientation," *MRS Bulletin* **35**, 173 (2010)
3. "One-shot structure determination," *Nature Methods* **7**, 96 - 97 (2010)
4. "Nanoscale 3D imaging in a single shot," *Chemistry World News*, rsc.org/chemistryworld/News, published online Dec. 17, 2009.
5. "Lensless Soft X-ray Microscopy System Achieves 70-nm Resolution," *Photonics Spectra* **42**, 112 (March 2008).
6. "Soft X-ray microscopy: on the table" in Research Highlights, *Nature Photon.* **2**, 64 (2008).
7. "Harmonic pictures in a flash," by J. Spence, Nature News and Views, *Nature* **449**, 553 (2007).
8. "Lensless X-ray microscope fits in the lab," by J. Cartwright, *Physics World News*, [Physicsworld.com](http://physicsworld.com), published online Sep 11, 2007.

SELECTED RESEARCH GRANT PROPOSALS

1. "Multiferroic Response Engineering in Mesoscale Oxide Structures," LANL LDRD-Directed Research Program, PI: Quanxi Jia, Co-I: Richard Sandberg, applied for in April 2013, funded July 2013, \$1.8M for 3 years (Sandberg portion is ~\$100k per year for 3 years).
2. "Development of an all fiber in-situ probe for pressure/temperature measurement of shock loaded polymers," LANL Science Campaign 2 R.L. Sandberg (PI), G. Rodriguez, \$180k for 2 year (2013-2014).

3. "Sub-picosecond diffractive imaging of a collapsing void in a shocked material," SLAC-LCLS X-Ray Free Electron Laser User Beamtime 5x12 hour shifts for January 2014.
4. "Coherent Diffractive Imaging of Ultrafast Eject Processes," LANL LDRD-Exploratory Research Program, PI: Cindy Bolme, Co-PI: Richard Sandberg, applied for in April 2012, funded July 2012, \$400k for 3 years.
5. "Ultrafast spectro-microscopy for nanoscale magnetic domain imaging," LANL LDRD-Exploratory Research Program, applied for in April 2011 for \$400k for 3 years, funded July 2011.

STUDENTS AND POSTDOCS MENTORED

Postdoctoral Researchers Mentored

1. 2013-Present – Dr. Brian McFarland – Director's Funded Postdoc, Los Alamos National Laboratory
2. 2014-2015 – Dr. Qiang Wang – Postdoctoral Fellow, now in Postdoc at Argonne Nat. Lab

Graduate Students Mentored

1. 2012 – Nathan Heilmann – Graduate student, Brigham Young University, now at KM Labs, Inc.

Undergraduate Students Mentored

1. Summer 2015 – Albert Liu – SULI Student – University of Michigan PhD program in Applied Physics
2. Summer 2015 – Timothy O'Leary – Undergraduate Researcher, BYU-Idaho, BS in Applied Math
3. 2014-2015 – Matthew C. Tyson – Post-bachelors Intern, Montana State University PhD Program
4. 2013-Current – Kimberley Nguyen – Undergraduate Researcher – B.S. Biochemistry, UNM
5. 2012-2013 – Jonathan Gigax – B.S. Student, Univ. Sci. Tech Mo., PhD candidate at Texas A&M

CONFERENCE PROCEEDINGS, REPORTS, PATENTS, AND PRESENTATIONS (SOME PEER REVIEWED)

Perspectives and Reports

1. J. Carpenter and R. Sandberg, "Perspective on the Use of Coherent Diffraction Imaging as a Tool for High Resolution Materials Characterization," *JOM* **65**, 1181–1182 (2013).
2. G. Rodriguez and R. L. Sandberg, "Chapter 9. Chirped Fiber Bragg Grating Detonation Velocity Sensing," pp. 81-103 in M. R. Furlanetto et al., "Gemini Post-Shot Data Report (U)," LA-CP-13-00554, May 10, 2013.

Patents:

1. Richard L. Sandberg, Nina Weisse-Bernstein, John L. Barber, Brian Bluhm, James Hunter, Scott Watson, Richard L. Sheffield "Prompt 3D X-ray Imaging of Integrated Circuits," *application pending* (2015).

Colloquia and Seminars:

1. "Sub-micron Scale Imaging of Fast Materials Dynamics at X-ray Free Electron Lasers," Department of Physics Colloquium, New Mexico State University, November 13, 2014, Las Cruces, New Mexico.
2. "Lensless X-ray Imaging for Materials Dynamics Studies," Brigham Young University Department of Physics and Astronomy Colloquium, October 29, 2014, Provo, Utah.
3. "Sub-micron Scale Imaging of Fast Materials Dynamics at X-ray Free Electron Lasers," SLAC Photon Science Seminar, SLAC National Accelerator Laboratory, April 29, 2014, Menlo Park, California.

4. "Carrier multiplication studies of lead-salt nanorods with a superconducting nanowire single photon detector," Department of Physics & Astronomy Colloquium, University of Denver, November 10, 2010, Denver, Colorado.
5. "Closing the Gap to the Diffraction Limit: Tabletop Soft X-Ray Coherent Diffractive Imaging," Physical Chemistry and Advanced Spectroscopy (C-PCS) Group Meeting, Chemistry Division, Los Alamos National Lab, November 17, 2009, Los Alamos, New Mexico.
6. "Tabletop Nanoscale X-ray Imaging for Nanotechnology Applications," Department of Physics and Astronomy Colloquium, Brigham Young University – Idaho, October 29, 2009, Rexburg, Idaho.
7. "Closing the Gap to the Diffraction Limit: Tabletop Soft X-Ray Coherent Diffractive Imaing," OpTec Seminar, Montana State University, October 27, 2009, Bozeman, Montana.
8. "Closing the Gap to the Diffraction Limit: Tabletop Soft X-Ray Coherent Diffractive Imaging," Department of Physics Seminar, University of California at Los Angeles, August 20, 2008, Los Angeles, California.
9. "Lensless Diffractive Microscopy Using Tabletop Extreme Ultraviolet (EUV) Sources," Department of Physics and Astronomy Colloquium, Brigham Young University, May 14, 2008, Provo, Utah.

Proceedings:

1. G. Rodriguez, R.L. Sandberg, B.M. Lalone, B.R. Marshall, M. Grover, G. Stevens, and E. Udd, "High pressure sensing and dynamics using high speed fiber Bragg grating interrogation systems," *SPIE Defense, Security, and Sensing* 90980C (2014).
2. E. Udd, G. Rodriguez, and R. L. Sandberg, "High-speed fiber grating pressure sensors," *SPIE Defense, Security, and Sensing* 90980B (2014).
3. G. Rodriguez, R.L. Sandberg, S.I. Jackson, S.W. Vincent, and E. Udd, "Fiber Bragg sensing of high explosive detonation experiments at Los Alamos National Laboratory," *J. Phys. Conf. Ser.* 500, 142030 (2014).
4. R.L. Sandberg, G. Rodriguez, L. Gibson, D. Dattelbaum, and E. Udd, "Embedded optical probes for simultaneous pressure and temperature measurement of materials in extreme conditions," *J. Phys. Conf. Ser.* 500, 142031 (2014).
5. (Invited) G. Rodriguez, R. L. Sandberg, S. I. Jackson, D. M. Dattelbaum, S. W. Vincent, Q. McCulloch, R. M. Martinez, S. M. Gilbertson, and E. Udd, "Fiber Bragg grating sensing of detonation and shock experiments at Los Alamos National Laboratory," *SPIE Defense, Security, and Sensing* **872204**, 872204–13 (2013)
6. R.L. Sandberg, D.D. Allred, L.J. Bissell, J.E. Johnson, R.S. Turley, "Uranium Oxide as a Highly Reflective Coating from 100-400 eV," in Proc. Int. Conf. Synch. Rad. Inst. American Institute of Physics, AIP. Conf. Proc. **705**, 796 (2003).
7. R. L. Sandberg, D. D. Allred, J. E. Johnson, R. S. Turley, "A Comparison of Uranium Oxide and Nickel as Single-layer Reflectors from 2.7 to 11.6 Nanometers," Proc. SPIE **5193**, 191-203 (2003).
8. R.L. Sandberg, D.D. Allred, S. Lunt, M.K. Urry, R.S. Turley, "Optical Properties and Application of Uranium-based Thin Films for the Extreme Ultraviolet and Soft X-ray Region", Proc. SPIE **5538**, 107 (2004).
9. R.E. Robinson, R.L. Sandberg, D.D. Allred, A.L. Jackson, J.E. Johnson, W. Evans, T. Doughty, A.E. Baker, K Adamson, and A. Jacquier "Removing Surface Contaminants from Silicon Wafers to Facilitate EUV Optical Characterization," 47th Ann. Tech. Conf., 368-376 (2005).
10. J.E. Johnson, D.D. Allred, R.S. Turley, W.R. Evans, and R.L. Sandberg, "Thorium-Based Thin Films as Highly Reflective Mirrors in the EUV," in *Actinides—Basic Science, Applications, and Technology*, Mat. Res. Soc. Symp. Proc. **893**, 207 (2006). (Peer reviewed).

11. C. Saravanan, S. Nirmalgandhi, O. Kritsun, R. Sandberg, A. Acheta, B. La Fontaine, H.J. Levinson, K. Lensing, M. Dusa, J. Hauschild, A. Pici, "Evaluating a scatterometry-based focus monitor technique for hyper-NA lithography," Proc. SPIE **6518**, 651806 (2007). (Peer reviewed)
12. O. Kritsun, B. La Fontaine, R.L. Sandberg, A. Acheta, H.J. Levinson, K. Lensing, M. Dusa, J. Hauschild, A. Pici, C. Saravanan, K. Primak, R. Korlahalli, S. Nirmalgandhi, "Evaluating the performance of a 193-nm hyper-NA immersion scanner using scatterometry," Proc. SPIE **6520**, 65200L (2007). (Peer reviewed)
13. T.I. Wallow, R. Kim, B. La Fontaine, P.P. Naulleau, C.N. Anderson, and R.L. Sandberg, "Progress in EUV photoresist technology," 23rd European Mask and Lithography Conference, edited by U.F.W. Behringer, Proc. SPIE **6533**, 653317 (2007). (Peer reviewed).
14. R.L. Sandberg, P.W. Wachulak, D.A. Raymondson, A. Paul, A.E. Sakdinawat, B. Amirbekian, E. Lee, Y. Liu, C. La-O-Vorakiat, C. Song, M.C. Marconi, C.S. Menon, M.M. Murnane, J.J. Rocca, H.C. Kapteyn, and J. Miao, "Lensless imaging using table-top soft x-ray lasers and high harmonics sources reaching 70 nm resolution," *X-Ray Lasers 2008*, C.L.S. Lewis and D. Riley, Editors, 433-438 (Springer Netherlands, 2009). (Peer reviewed)
15. D.A. Raymondson, R.L. Sandberg, W.F. Schlotter, K.S. Raines, C. La-O-Vorakiat, A. Paul, A.E. Sakdinawat, M.M. Murnane, H.C. Kapteyn, and J. Miao, "90 nm Lensless Microscopy and Holography using Tabletop Coherent Soft X-Rays," *Ultrafast Phenomena XVI*, P. Corkum, et al., Editors., 146-148 (Springer Berlin Heidelberg. 2009). (Peer reviewed)
16. R.L. Sandberg, D.A. Raymondson, W.F. Schlotter, K.S. Raines, C. La-O-Vorakiat, A. Paul, M.M. Murnane, H.C. Kapteyn, and J. Miao, "Near diffraction limited coherent diffractive imaging with tabletop soft x-ray sources," Proceedings of the 2008 Conference on X-ray Microscopy, Journal of Physics: Conference Series **186**, 012058 (2009). (Peer reviewed)
17. D.A. Raymondson, R.L. Sandberg, W.F. Schlotter, K.S. Raines, C. La-O-Vorakiat, M. Seaberg, E. Townsend, A. Paul, S. Backus, M.M. Murnane, H.C. Kapteyn, and J. Miao, "13.5 nm Tabletop Diffractive Microscopy with Sub-100 nm Resolution," 2009 Advanced Microlithography Conference, Proc. SPIE 7272, 72720F (2009). (Peer reviewed)

Conference Talks (First author is presenter unless stated):

1. **Invited Talk:** Richard L. Sandberg, "Studying Shocked Material Dynamics with Ultrafast X-rays" Microscopy and Microanalysis 2015, August 2-6, 2015, Portland, Oregon.
2. **Invited Talk:** George Rodriguez, Fedor F. Balakirev, Abul Azad, Richard L. Sandberg, Bruce R. Marshall, Bryan F. Henson, Laura Smilowitz, Mark Marr-Lyon, "Insight into fiber Bragg sensor response at 100-MHz interrogation rates under various dynamic loading conditions" SPIE DSS 2015, April 22, 2015, Baltimore, Maryland.
3. Brian K. McFarland, Jian-Xin Zhu, Rohit Prasankumar, George Rodriguez, Richard Sandberg, Antoinette Taylor, Dmitry Yarotski "Ultrafast Dynamics near the M-edge in Chromium" APS March Meeting, March 3, 2015, San Antonio, TX.
4. **Invited Talk:** Kyle Ramos, Brian Jensen, Adam Iverson, David Montgomery, Richard L. Sandberg, John Barber, Kamel Fezzaa, "Characterization of Materials through High Resolution Coherent Imaging," TMS 2015, March 16, 2015, Orlando, FL.
5. **Invited Talk:** Edwin Fohtung, Ross Harder, Oleg Shpyrko, Richard L. Sandberg, Boris Kieffer, Eric Fullerton, "Observing Nanoscale Magnetostriction with Coherent X-rays in DC and Pulsed Magnetic Fields," TMS 2015, March 16, 2015, Orlando, FL.
6. Richard L. Sandberg, Cindy Bolme, Kyle Ramos, Virginia Hamilton, Tim Pierce, John L Barber, Brian Abbey, Andreas Schropp, Frank Seiboth, Phil Heiman, Bob Nagler, Eric Galtier, Eduardo Granados, "Characterization of Materials through High Resolution Coherent Imaging," TMS 2015, March 17, 2015.

7. Matthew Tyson , Kimberly Nguyen , Jonathan Gigax , Richard L. Sandberg, "Fresnel-regime Coherent Diffractive Imaging using Tabletop Sources," APS 4 Corners Meeting, October 17, 2014, Orem, UT.
8. **Invited talk:** R.L. Sandberg "Ultrafast Coherent Imaging of Shocked Material Dynamics with X-ray Free Electron Laser Pulses," 2014 High-Power Laser Workshop, SLAC National Accelerator Laboratory, October 8, 2014, Menlo Park, California.
9. **Invited talk:** R.L. Sandberg "Probing multiferroic materials with Soft X-ray Coherent Diffraction Imaging," 2014 LCLS/SSRL Users Meeting, SLAC National Accelerator Laboratory, October 10, 2014, Menlo Park, California.
10. R.L. Sandberg, C. Bolme, K. Ramos, Q.McCulloch, R. Martinez, V. Hamilton, T. Pierce, J.L. Barber, B. Abbey, A. Schropp, R. Hoppe, F. Sieboth, P. Heiman, B. Nagler, E. Galtier, E. Granados, "Ultrafast Imaging of Shocked Material Dynamics with X-ray Fee Electron Laser Pulses," International Workshop on Phase Retrieval and Coherent Scattering, Northwestern University, Chicago, Illinois, September 2-5, 2014 (Poster Presentation).
11. R. L. Sandberg, C. Bolme, K. Ramos, Q. McCulloch, J. L. Barber, R. Martinez, M. Greenfield, S. D. McGrane, B. Abbey, A. Schropp, F. Sieboth, P. Heiman, B. Nagler, E. C. Galtier, and E. Granados, "Ultrafast Imaging of Shocked Material Dynamics with X-ray Fee Electron Laser Pulses," in **CLEO: 2014 Postdeadline Talk**, OSA Conference on Lasers and Electro-Optics, STh5C.8, San Jose, CA (June, 2014)
12. **Invited Talk:** R.L. sandberg, "Nanometer Scale Materials Studies with Tabletop Soft X-Ray Coherent Imaging," TMS 2013, San Antonio, TX, March 2013.
13. Richard L. Sandberg, Cris Barnes, John Barber, Richard Sheffield, "Diffractive Imaging at Large Fresnel Number and the Challenge of Dynamic Mesoscale Imaging of Materials," TMS 2013, San Antonio, TX, March 2013.
14. **Invited Talk:** Richard L. Sandberg, George Rodriguez, Scott I. Jackson, et al., "Fiber Bragg grating sensing of detonation and shock experiments at Los Alamos National Laboratory ", SPIE Defense, Security, and Sensing, Baltimore, MD, May 2013.
15. G. Rodriguez, R.L. Sandberg, S.I. Jackson, S.W. Vincent, and E. Udd, "Fiber Bragg sensing of high explosive detonation experiments at Los Alamos National Laboratory," 2013 Joint APS-SCCM/AIRAPT Conference, Seattle, WA, July, 2013
16. R.L. Sandberg, G. Rodriguez, L. Gibson, D. Dattelbaum, and E. Udd, "Embedded optical probes for simultaneous pressure and temperature measurement of materials in extreme conditions," 2013 Joint APS-SCCM/AIRAPT Conference, Seattle, WA, July, 2013.
17. A. Gleason, C. Bolme, W. Mao, W. Yang, H.J. Lee, B. Nagler, E. Galtier, D. Milathianaki, R. Sandberg, "Ultrafast x-ray studies on the dynamics of structural transitions in amorphous and crystalline SiO₂," 2013 Joint APS-SCCM/AIRAPT Conference, Seattle, WA, July, 2013.
18. N. R. Weisse-Bernstein, R.L. Sandberg, T. Williamson, M.P. Croce, M. Rabin, "Time jitter measurement ultra fast compound nanowire single photon sensors in the near infrared," Low Temperature Detector Conference, Pasadena, CA, July 2013.
19. R. L. Sandberg, Q. McCullouch, A. M. Dattelbaum, K. W. Staggs, and R. George, "Nondestructive Calibration of Chirped Fiber Bragg Grating Sensors using a Fiber-Based Ultrafast Laser," in OSA Conference on Lasers and Electro-Optics, AW3J.2, San Jose, Ca, May 2012.
20. R. L. Sandberg, D. F. Gardner, M. D. Seaberg, D. E. Adams, H. C. Kapteyn, M. M. Murnane, and J. L. Barber, "Fresnel-regime coherent diffractive imaging using a tabletop soft x-ray source," OSA Conference on Lasers and Electro-Optics, San Jose, Ca, May 2012.
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